

**REMARKS**

By the present amendment, the paragraph beginning at line 12 of page 10 has been amended to delete the term block, in accordance with the Office Action's suggestion. Additionally, claims 30 and 35 have been amended to change the term "secondary diol" to "2,4-pentanediol". The change of the term "secondary diol" to "2,4-pentanediol" was previously performed in the amendment dated February 1, 2002. This change, however, was not reflected in the amendment dated October 24, 2002. Thus, the amendment to claims 30 and 35 merely corrects an error that was made in the previous amendment and overcomes the 35 U.S.C. §112 second paragraph rejection.

The present amendment merely reduces the number of issues for appeal by reducing the number of 35 U.S.C. §112 rejections (i.e., the first paragraph rejection with respect to the term "block" and the second paragraph rejection with respect to the term "secondary diol"). Therefore, a showing under 37 C.F.R. §1.116(b) is not believed to be needed and entry of the amendment is respectfully requested.

Below is a discussion of the Office Action's 35 U.S.C. §112 first paragraph rejection, 35 U.S.C. §112 second paragraph rejection, and 35 U.S.C. §103 rejections.

**I. 35 U.S.C. §112, first paragraph, rejections.**

The Office Action's 35 U.S.C. 112, first paragraph, rejections will be discussed below as they are presented in the Office Action.

**A.** The Office Action states that deletion of the term block is per se okay but has not been carried out throughout.

The specification has been amended to delete the only remaining term "block" (which the Office Action noted) that the Applicant could find. An additional search using the find feature of the applicant's word processing program resulted in no additional terms "block" being found. The applicant therefore respectfully requests that this rejection be withdrawn.

B. The Office Action states, "Further, 'segments' appears to be residue of the block language." It is unclear to the applicant what the Office Action means by this. Does the Office Action mean the term "segment" should be deleted from the specification? If so, this is the first time the Office Action has indicated that this language is a problem in the specification. The applicant respectfully ask the Office Action clarify this statement so the applicant can address this rejection on appeal.

C. The Office Action asserts that the nature of the polymer in the invention is critical or essential to the practice of the invention, but it is neither claimed nor enabled by the disclosure. The Office Action notes, at the last paragraph on page 2 and continuing to page 3, various references, which utilize the term "block". The first paragraph on page 3 then concludes that this is not what the Applicant is doing. At line 9, of page 3, the Office Action states that Holden et al., Thermoplastic Elastomers, further teach the term "segment", but this is not what the applicant is doing.

A patent application is required to contain a written description of the invention only with respect to the claimed subject matter. The written description requirement does not apply to features of an invention that are not included in the claim section of the patent application. In re Moore, 169 USPQ 236, 238-239 (C.C.P.A. 1971). Id.

The term block has been deleted from the specification as well as from the claims. The term "segment" is also not used in the claims. Thus, none of the claims includes these terms. Therefore, a 35 U.S.C. §112 rejection with respect to these terms is no longer relevant because these terms are not used to describe the inventions defined by the claims.

Moreover, claim 20, which is the broadest of the claims, is described in the specification in such a way to reasonably convey to one skilled in the art that the inventor at the time of the application had possession of the claimed invention. Claim 20 recites that the gas generating material includes:

"a thermoplastic elastomer consisting essentially of a polyurethane formed from an aromatic diisocyanate, hydroxyl terminated glycidyl azide polymer with a hydroxyl functionality of two or less, and optionally 2,4 pentanediol, wherein the amount of aromatic diisocyanate, hydroxyl terminated glycidyl azide polymer, 2,4-pentanediol used to form the polyurethane are controlled so that the ratio of isocyanate groups to hydroxyl groups used to form the polyurethane is about 1."

The specification at page 10 and page 11 show that in a preferred embodiment of the invention 4,4-methylene bis-phenylisocyanate is reacted with GAP-1000 to form GAP-M. GAP-1000, as shown on page 11, is a hydroxyl terminated glycidyl

azide polymer with a hydroxyl functionality of two. 4,4-methylene bis-phenylisocyanate is an aromatic diisocyanate. GAP-M, as shown on page 11, is a polyurethane. As stated on page 9, lines 14+, if the amount of aromatic diisocyanate and GAP are controlled so that the ratio of isocyanate groups to hydroxyl groups is about 1, a thermoplastic polyurethane elastomer will form.

Thus, the subject matter of claim 20 is described in the specification in such a way to one of ordinary skill in the art that Applicant had possession of the claimed invention at the time the application was filed. Therefore, withdrawal of this rejection is respectfully requested.

D. The Office Action states at the second paragraph of page 3, and the first paragraph of page 4, that,

"further definitions for polymer and polyurethane, for example, show that the Applicant has misused language throughout the application regarding polymer details."

The Office Action, however, provides no specific examples of how these definitions are misused in the application. Moreover, the reaction of GAP-1000 and 4,4'-methylene bis-phenylisocyanate clearly forms a polyurethane and glycidyl azide polymer is clearly a polymer. Accordingly, the Applicant requests that the Office Action provide some basis for this assertion or withdraw this rejection.

E. The Office Action states that claim 30 still includes the term secondary diol.

Claim 30 was amended in an Office dated February 1, 2002 to change the term secondary diol to 2,4-pentanediol. The

amendment to claim 30 was not reflected in the amendment to claim 30 dated October 4, 2002. The present amendment corrects this problem. Therefore, withdrawal of this rejection is respectfully requested.

**F.** The Office Action then states that throughout the specification and claims, incorrect language or terminology is used to such an extent that the ordinary artisan is not taught what the invention is, or how to practice it.

As noted above, the claimed invention, the part of which relates to a thermoplastic elastomer that comprises a polyurethane formed from glycidyl azide polymer and an aromatic diisocyanate is clearly taught on a pages 10 and 11.

**G.** The Office Action states that the idea of physical cross-linking is not correctly conveyed to one of ordinary skill in the art, that it is not clear what the difference between what Applicant does and what Hawley's teaches occurs for all polyurethane elastomers, and that this basis is not sufficient for perverting ordinary art understood language.

The Applicants again fail to see the relevance of this argument. The idea of physically cross-linking is not claimed. Since this feature is not claimed, any written description with respect to this term is not relevant for rejection of claims under 35 U.S.C. §112, first paragraph.

**H.** the Office Action states that claim 20 as amended has been expanded to encompass any polyurethane, which also lacks proper disclosure basis.

Claim 20 was not expanded to encompass all polyurethanes. Claim 20 is limited to polyurethanes formed from glycidyl

azide polymers with a hydroxyl functionality of two or less and aromatic diisocyanates, which was within the scope of the originally filed application.

I. The Office Action states that the term block can be found at page 10, line 14. The applicant respectfully notes this and has amended the specification to delete it. With respect, to the term "segment", the Applicant notes that this term is not included in the claims, nor is it necessary to understand the invention defined by the claims. Therefore, whether it remains or does not remain in the specification is not relevant, because as noted above the subject matter of claims is clearly supported by the specification.

**II. 35 U.S.C. §112, second paragraph, rejections**

Claims 20, 22, 24-30, 35 and 36 were rejected under 35 U.S.C. §112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter, which Applicant regards as the invention.

The Office Action states the term secondary diol in claim 30 is improper. As noted above, claim 30 was previously amended in an amendment dated February 1, 2002. Claim 35 was also amended in the amendment dated February 1, 2002. These changes were, however, not reflected in the amendment of the claims dated October 4, 2002. Accordingly, the present amendment corrects this error. Thus, withdrawal of this rejection is respectfully requested.

**III. 35 U.S.C. §103(a), rejections**

A. Obviousness rejection in view of Zeigler, Manzara et al., Manser, and Gomez et al.

Claims 20, 22, 24-30, 35 and 36 were rejected under 35 U.S.C. §103(a) as being unpatentable over Re. 36,296 to Zeigler in view of U.S. Patent No. 5,164,521 to Manzara et al., U.S. Patent No. 4,393,199 to Manser, and U.S. Patent No. 5,319,037 to Gomez.

Claim 20 is patentable over Zeigler in view of Manzara et al., Manser, and Ochoa Gomez et al. because Zeigler in view of Manzara et al., Manser, and Ochoa Gomez et al. do not disclose or suggest (1) a thermoplastic elastomer that consists essentially of a polyurethane formed from an aromatic diisocyanate, hydroxyl terminated glycidyl azide polymer, and optionally 2,4-pentanediol and (2) that the amount of aromatic diisocyanate, hydroxyl terminated glycidyl azide polymer, and 2,4 pentanediol used to form the polyurethane are controlled so that the ratio of isocyanate groups to hydroxyl groups used to form the polyurethane is about 1.

As noted in the Office Action Zeigler teaches the basic idea of an air bag system with a gas generating composition that comprises an oxidizer of ammonium nitrate, a fuel (e.g., HMX or RDX), and an energetic GAP binder. Zeigler further states that:

"These materials are normally liquid materials and need to be formulated with an appropriate amount of a suitable curative to crosslink the material, e.g., from about 10-15% by weight based on the weight of binder of a multifunctional isocyanate such as hexamethylene diisocyanate and/or 4,4'-

diisocyanatodicyclohexyl-methane."  
(Column 4, lines 7-12).

Zeigler does not teach or suggest that the cross-linked glycidyl azide polymer forms a thermoplastic elastomer. Zeigler teaches that a suitable curative is used to cross-link the glycidyl azide polymer.

A binder, which is cured by cross-linking, is generally not considered to be thermoplastic. To support the assertion that a binder, which is cured by cross-linking, is generally not considered to be a thermoplastic, the Applicant first refers to Whittington's Dictionary of Plastics (see copy of attachment to February 1, 2002 amendment. Whittington's Dictionary of Plastics at page 59 and 60 defines the term "cured" as,

"To change the properties of a plastic or resin by chemical reaction, which for example may be condensation, polymerization, or addition; usually accomplished by the action of either heat or catalyst or both, and with or without pressure. The term cure is used almost exclusively in connection with thermosetting plastics, vulcanizable elastomers and rubbers."

Additionally, Hawley's Condensed Chemical Dictionary (see copy attached to February 1, 2002 amendment) on page 325 defines cross-linking as the,

"Attachment of two chains of polymer molecules by bridges, composed of either, an element, a group, or a compound, which join certain carbon atoms of the chains by primary chemical bonds."



Hawley's Condensed Chemical Dictionary further notes

that,

"cross-linking has the effect of changing a plastic from thermoplastic to thermosetting".

Thus, Whittington's Dictionary of Plastics teaches that curing is used in conjunction with thermosetting plastics and Hawley's Condensed Chemical Dictionary teaches that cross-linking changes a plastic from thermoplastic to thermosetting.

If a "suitable curative" is used to "crosslink" the glycidyl azide polymer, a person skilled in the art would assume, based on the definitions of "cure" and "cross-link", that a thermosetting material is formed, not a thermoplastic material. Therefore, there is nothing in Zeigler that teaches or suggests that the glycidyl azide polymer cross-linked by the multifunctional isocyanate forms a thermoplastic elastomer.

Additionally, Zeigler does not teach using an aromatic diisocyanate and that the amount of aromatic diisocyanate, hydroxyl terminated glycidyl azide polymer, and 2, 4-pentanediol used to form the polyurethane are controlled so that the ratio of isocyanate groups to hydroxyl groups used to form the polyurethane is about 1.

Manzara et al. teach a hydroxyl terminated poly(glycidyl azide) with a hydroxyl functionality of up to 4 or more. Manzara et al. further teach that when using GAP as a binder for a solid rocket propellant GAP can be mixed with a polyisocyanate curing agent.

Manzara et al. do not teach that the glycidyl azide polymers can be formed into thermoplastic elastomers.

Manzara et al. teach that the glycidyl azide polymer can be combined with a polyisocyanate curing agent and heated to a cure temperature until a solid, elastomeric polyurethane matrix is formed (column 16, 4-13). There is no suggestion in Manzara et al. that this polyurethane matrix is a thermoplastic elastomer.

Manzara et al. also teach that glycidyl azide polymers converted to polyurethanes have good mechanical properties over the temperature range of -50°C to 120°C but can be advantageously be decomposed at temperatures below 130°C-150°C. (Col. 16, lines 46-48). Decomposition of a glycidyl azide polyurethane at temperatures below 130°C-150°C indicates that the polyurethane is not a thermoplastic. Thermoplastics do not decompose at temperatures below 130°C-150°C, but instead generally melt. Thus, there is nothing in Manzara et al. that discloses or suggests a thermoplastic elastomer that is a polyurethane.

Additionally, there is nothing in Manzara et al. that discloses or suggests that the amount of aromatic diisocyanate, hydroxyl terminated glycidyl azide polymer, and 2,4 pentanediol used to form the polyurethane are controlled so that the ratio of isocyanate groups to hydroxyl groups used to form the polyurethane is about 1.

Manser teach that block polymers such as THF and BDO can be formed with functionalities ranging from 0 to 4 (column 6,

lines 35-47). Manser further teaches that if a difunctional polymer is copolymerized with a monomer, such as a diisocyanate, a linear copolymer will result and that if a trifunctional polymer is copolymerized with a diisocyanate, a cross-linked polymer will result. (Column 6, lines 49-67). Manser teaches difunctional and trifunctional polymers can be mixed to control with exactitude the cross-linking density.

Manser does not teach that block polymers such as THF and BDO can be copolymerized with a monomer such as a diisocyanate to form a thermoplastic elastomer. Manser, as noted above, teaches controlling the cross-linking density of the polymer. A cross-linked polymer would not be a thermoplastic elastomer because the cross-linking would inhibit thermoplastic behavior.

Additionally, as discussed with regard to Manzara et al., there is nothing that discloses or suggests that the amount of aromatic diisocyanate, and hydroxyl terminated glycidyl azide polymer used to form the polyurethane are controlled so that the ratio of isocyanate groups to hydroxyl groups used to form the polyurethane is about 1.

Ochoa Gomez et al. teach a method of synthesizing a glycidyl azide polymer with a hydroxyl functionality of two or more from polyepichlorohydrin.

Ochoa Gomez et al. do not teach reacting the GAP polymer with an aromatic isocyanate to form a thermoplastic elastomer or controlling the amount of aromatic diisocyanate, hydroxyl terminated glycidyl azide polymer, and secondary diol so that

the ratio of isocyanate groups to hydroxyl groups used to form the polyurethane is about 1.

Thus, Zeigler in view of Manzara et al., Manser, and Ochoa Gomez et al. do not teach thermoplastic elastomer which is a polyurethane formed from hydroxyl terminated glycidyl azide polymer, an aromatic diisocyanate, and optionally 2,4 pentanediol. Moreover, Zeigler in view of Manzara et al., Manser, and Ochoa Gomez et al. do not teach controlling the amount of aromatic diisocyanate, hydroxyl terminated glycidyl azide polymer, and 2,4 pentanediol so that the ratio of isocyanate groups to hydroxyl groups used to form the polyurethane is about 1. Therefore, claim 20 is patentable over Zeigler in view Manzara et al., Manser, and Ochoa Gomez et al., and allowance of Claim 20 is respectfully requested.

Claim 22 depends from claim 20 and further recites that the aromatic diisocyanate is 4,4'-methylene bis-phenylisocyanate.

As discussed above with respect to claim 20, Zeigler in view of Manzara et al., Manser, and Ochoa Gomez et al. do not disclose or suggest a thermoplastic elastomer that consists essentially of a polyurethane formed from an aromatic diisocyanate, hydroxyl terminated glycidyl azide polymer, and optionally 2,4-pentanediol and that the amount of aromatic diisocyanate, hydroxyl terminated glycidyl azide polymer, and 2,4 pentanediol used to form the polyurethane are controlled so that the ratio of isocyanate groups to hydroxyl groups used to form the polyurethane is about 1. Therefore, claim 22

is allowable for the same reasons as claim 20 and for the specific limitations recited in claim 22.

Claim 24 depends from claim 20 and further recites that the hydroxyl terminated glycidyl azide polymer has a molecular weight from about 25,000 g/mole to about 35,000 g/mole and a hydroxyl functionality of 2.

As discussed above with respect to claim 20, Zeigler in view of Manzara et al., Manser, and Ochoa Gomez et al. do not disclose or suggest a thermoplastic elastomer that consists essentially of a polyurethane formed from an aromatic diisocyanate, hydroxyl terminated glycidyl azide polymer, and optionally 2,4-pentanediol and that the amount of aromatic diisocyanate, hydroxyl terminated glycidyl azide polymer, and 2,4 pentanediol used to form the polyurethane are controlled so that the ratio of isocyanate groups to hydroxyl groups used to form the polyurethane is about 1. Moreover, Zeigler in view of Manzara et al., Manser, and Ochoa Gomez et al. do not teach a glycidyl azide polymer that has a molecular weight from about 25,000 g/mole to about 35,000 g/mole and a hydroxyl functionality of 2. Therefore, claim 24 is allowable for the same reasons as claim 20 and for the specific limitations recited in claim 24.

Claim 25 depends from claim 20 and further recites that the inorganic salt oxidizer is selected from the group consisting of alkali metal nitrates, alkaline earth metal nitrate, alkali metal perchlorates, alkaline earth metal perchlorates, ammonium perchlorate, and ammonium nitrate.

As discussed above with respect to claim 20, Zeigler in view of Manzara et al., Manser, and Ochoa Gomez et al. do not disclose or suggest a thermoplastic elastomer that consists essentially of a polyurethane formed from an aromatic diisocyanate, hydroxyl terminated glycidyl azide polymer, and optionally 2,4-pentanediol and that the amount of aromatic diisocyanate, hydroxyl terminated glycidyl azide polymer, and 2,4 pentanediol used to form the polyurethane are controlled so that the ratio of isocyanate groups to hydroxyl groups used to form the polyurethane is about 1. Therefore, claim 25 is allowable for the same reasons as claim 20 and for the specific limitations recited in claim 25.

Claim 26 depends from claim 20 and further recites that the inorganic salt oxidizer is phase stabilized ammonium nitrate.

As discussed above with respect to claim 20, Zeigler in view of Manzara et al., Manser, and Ochoa Gomez et al. do not disclose or suggest a thermoplastic elastomer that consists essentially of a polyurethane formed from an aromatic diisocyanate, hydroxyl terminated glycidyl azide polymer, and optionally 2,4-pentanediol and that the amount of aromatic diisocyanate, hydroxyl terminated glycidyl azide polymer, and 2,4 pentanediol used to form the polyurethane are controlled so that the ratio of isocyanate groups to hydroxyl groups used to form the polyurethane is about 1. Therefore, claim 26 is allowable for the same reasons as claim 20 and for the specific limitations recited in claim 26.

Claim 27 depends from claim 20 and recites that the gas generating material further comprises a supplemental fuel.

As discussed above with respect to claim 20, Zeigler in view of Manzara et al., Manser, and Ochoa Gomez et al. do not disclose or suggest a thermoplastic elastomer that consists essentially of a polyurethane formed from an aromatic diisocyanate, hydroxyl terminated glycidyl azide polymer, and optionally 2,4-pentanediol and that the amount of aromatic diisocyanate, hydroxyl terminated glycidyl azide polymer, and 2,4 pentanediol used to form the polyurethane are controlled so that the ratio of isocyanate groups to hydroxyl groups used to form the polyurethane is about 1. Therefore, claim 27 is allowable for the same reasons as claim 20 and for the specific limitations recited in claim 27.

Claim 28 depends from claim 27 and further recites that the supplemental fuel is cyclotrimethylenetrinitramine.

As discussed above with respect to claim 20, Zeigler in view of Manzara et al., Manser, and Ochoa Gomez et al. do not disclose or suggest a thermoplastic elastomer that consists essentially of a polyurethane formed from an aromatic diisocyanate, hydroxyl terminated glycidyl azide polymer, and optionally 2,4-pentanediol and that the amount of aromatic diisocyanate, hydroxyl terminated glycidyl azide polymer, and 2,4 pentanediol used to form the polyurethane are controlled so that the ratio of isocyanate groups to hydroxyl groups used to form the polyurethane is about 1. Therefore, claim 28 is allowable for the same reasons as claim 20 and for the specific limitations recited in claim 28.

Claim 29 depends from claim 20 and further recites that the components of the gas generating material are present in a weight ratio adjusted to produce upon combustion a reaction gas product that consists essentially of carbon dioxide, nitrogen, and water.

As discussed above with respect to claim 20, Zeigler in view of Manzara et al., Manser, and Ochoa Gomez et al. do not disclose or suggest a thermoplastic elastomer that consists essentially of a polyurethane formed from an aromatic diisocyanate, hydroxyl terminated glycidyl azide polymer, and optionally 2,4-pentanediol and that the amount of aromatic diisocyanate, hydroxyl terminated glycidyl azide polymer, and 2,4 pentanediol used to form the polyurethane are controlled so that the ratio of isocyanate groups to hydroxyl groups used to form the polyurethane is about 1. Therefore, claim 29 is allowable for the same reasons as claim 20 and for the specific limitations recited in claim 29.

Claim 30 depends from claim 20 and further recites that the polyurethane is formed from an aromatic diisocyanate, a linear energetic polymer with a hydroxyl functionality of two or less, and 2,4 pentanediol.

As discussed above with respect to claim 20, Zeigler in view of Manzara et al., Manser, and Ochoa Gomez et al. do not disclose or suggest a thermoplastic elastomer that consists essentially of a polyurethane formed from an aromatic diisocyanate, hydroxyl terminated glycidyl azide polymer, and optionally 2,4-pentanediol and that the amount of aromatic diisocyanate, hydroxyl terminated glycidyl azide polymer, and



2,4 pentanediol used to form the polyurethane are controlled so that the ratio of isocyanate groups to hydroxyl groups used to form the polyurethane is about 1. Moreover, Zeigler in view of Manzara et al., Manser, and Ochoa Gomez et al. do not disclose or suggest a polyurethane is formed from an aromatic diisocyanate, hydroxyl terminated glycidyl azide polymer with a hydroxyl functionality of two or less, and 2,4 pentanediol. Therefore, claim 30 is allowable for the same reasons as claim 20 and for the specific limitations recited in claim 30.

Claim 35 recites an apparatus comprising an inflatable vehicle occupant protection device and a gas generating material that, when ignited produces gas to inflate the inflatable vehicle occupant protection device. The gas generating material comprises about 65% to about 90%, by weight of the gas generating material, an inorganic oxidizer salt and about 5% to about 35%, by weight of the gas generating material a thermoplastic elastomer. The thermoplastic elastomer comprises a polyurethane formed from 4,4'-methylene bis-phenylisocyanate, hydroxyl terminated glycidyl azide polymer with a hydroxyl functionality of two or less, and optionally 2,4 pentanediol. The amount 4,4'-methylene bis-phenylisocyanate, hydroxyl terminated glycidyl azide polymer, and 2,4 pentanediol used to form the polyurethane are controlled so that the ratio of isocyanate groups to the hydroxyl groups used to form the polyurethane thermoplastic elastomer is about 1.

As discussed above with respect to claim 20, Zeigler in view of Manzara et al., Manser, and Ochoa Gomez et al. do not disclose or suggest a thermoplastic elastomer that consists essentially of a polyurethane formed from an aromatic diisocyanate, hydroxyl terminated glycidyl azide polymer, and optionally 2,4-pentanediol and that the amount of aromatic diisocyanate, hydroxyl terminated glycidyl azide polymer, and 2,4 pentanediol used to form the polyurethane are controlled so that the ratio of isocyanate groups to hydroxyl groups used to form the polyurethane is about 1. Therefore, claim 35 is allowable for the same reasons as claim 20 and for the specific limitations recited in claim 35.

Claim 36 depends from claim 35 and further recites that the polyurethane is formed from 4,4'-methylene bis-phenylisocyanate, hydroxyl terminated glycidyl azide polymer with a hydroxyl functionality of two or less, and 2,4 pentanediol.

As discussed above with respect to claim 20, Zeigler in view of Manzara et al., Manser, and Ochoa Gomez et al. do not disclose or suggest a thermoplastic elastomer that consists essentially of a polyurethane formed from an aromatic diisocyanate, hydroxyl terminated glycidyl azide polymer, and optionally 2,4-pentanediol and that the amount of aromatic diisocyanate, hydroxyl terminated glycidyl azide polymer, and 2,4 pentanediol used to form the polyurethane are controlled so that the ratio of isocyanate groups to hydroxyl groups used to form the polyurethane is about 1. Therefore, claim 36

is allowable for the same reasons as claim 20 and for the specific limitations recited in claim 36.

B. Obviousness rejection in view of Finck et al., Wardle, Biddle et al., and Menke et al.

Claims 20-37 were rejected under 35 U.S.C. §103(a) as being unpatentable over U.S. Patent No. 5,525,171 to Finck et al., U.S. Patent No. 4,806,613 to Wardle, U.S. Patent No. 4,919,737 to Biddle et al., U.S. Patent No. 5,596,168 to Menke et al., and U.S. Patent No. 5,589,661 to Menke et al.

Claim 20 is patentable over Finck et al. in view of Wardle, Biddle et al., Menke '168, and Menke '661, because Finck et al. in view of Wardle, Biddle et al., Menke '168, and Menke '661 do not disclose or suggest (1) a thermoplastic elastomer that consists essentially of a polyurethane of an aromatic diisocyanate, hydroxyl terminated glycidyl azide polymer, and optionally 2,4-pentanediol and (2) that the amount of aromatic diisocyanate, hydroxyl terminated glycidyl azide polymer, and 2,4 pentanediol used to form the polyurethane are controlled so that the ratio of isocyanate groups to hydroxyl groups used to form the polyurethane is about 1.

As noted in the Office Action, Finck et al. teach that the compositions described in French application 9207067 consist of the product of the reaction of a glycidyl polyazide with a polyisocyanate as binder and of ammonium nitrate as oxidizing agent.

Finck et al. does not teach or suggest that the cross-linked glycidyl polyazide forms a thermoplastic elastomer.

Finck et al. teaches that these compositions are difficult to process because they rely on crosslinkable binders which cure very quickly.

A binder, which is cured by cross-linking, is generally not considered to be thermoplastic. To support the assertion that a binder, which is cured by cross-linking, is generally not considered to be a thermoplastic, the Applicant first refers to Whittington's Dictionary of Plastics. Whittington's Dictionary of Plastics at page 59 and 60 defines the term

"cured" as,

"To change the properties of a plastic or resin by chemical reaction, which for example may be condensation, polymerization, or addition; usually accomplished by the action of either heat or catalyst or both, and with or without pressure. The term cure is used almost exclusively in connection with thermosetting plastics, vulcanizable elastomers and rubbers."

Additionally, Hawley's Condensed Chemical Dictionary on page 325 defines cross-linking as the,

"Attachment of two chains of polymer molecules by bridges, composed of either, an element, a group, or a compound, which join certain carbon atoms of the chains by primary chemical bonds."

Hawley's Condensed Chemical Dictionary further notes that,

"cross-linking has the effect of changing a plastic from thermoplastic to thermosetting".

Thus, Whittington's Dictionary of Plastics teaches that curing is used in conjunction with thermosetting plastics and Hawley's Condensed Chemical Dictionary teaches that cross-

linking changes a plastic form thermoplastic to thermosetting. If a "suitable curative" is used to "crosslink" the glycidyl azide polymer, a person skilled in the art would assume, based on the definitions of "cure" and "cross-link", that a thermosetting material is formed, not a thermoplastic material. Therefore, there is nothing in Finck et al. that teaches or suggests that the glycidyl polyazide cross-linked by a polyisocyanate forms a thermoplastic elastomer.

Additionally, Finck et al. do not teach using an aromatic diisocyanate and that the amount of aromatic diisocyanate, hydroxyl terminated glycidyl azide polymer, and 2,4-pentanediol used to form the polyurethane are controlled so that the ratio of isocyanate groups to hydroxyl groups used to form the polyurethane is about 1.

Wardle teach that two methods have been previously proposed for producing thermoplastic elastomers, which are derived from cyclic ethers. (Column 2, lines 25-29, lines 57-60). In one method, polymers may be joined together through a block linking technique in which an isocyanate linking moiety is used. (Column 2, lines 59-62).

Wardle, however, do not teach a thermoplastic elastomer that comprises a polyurethane of an aromatic diisocyanate, hydroxyl terminated glycidyl azide polymer, and optionally 2,4-pentanediol and that the amount of aromatic diisocyanate, hydroxyl terminated glycidyl azide polymer, and 2,4-pentanediol used to form the polyurethane are controlled so that the ratio of isocyanate groups to hydroxyl groups used to form the polyurethane is about 1.

Biddle et al. teach (AB)<sub>n</sub> thermoplastic elastomers can be formed with polyglycidyl azide as a soft block using a technique described in the Wardle patent. The technique described in the Wardle patent involves linking a hard block polymer with a soft block polymer using an isocyanate linkage. Wardle teaches that the isocyanate linkage can be formed from aromatic diisocyanates.

Biddle et al. in view of Wardle do not teach a thermoplastic elastomer that consists essentially of a polyurethane formed from an aromatic diisocyanate, hydroxyl terminated glycidyl azide polymer, and optionally 2,4-pentanediol. The thermoplastic elastomers in Biddle et al. and Wardle all require an additional polymer, which forms the hard block.

Further, Biddle et al. in view of Wardle do not teach that the amount of aromatic diisocyanate, hydroxyl terminated glycidyl azide polymer, and 2,4 pentanediol used to form the polyurethane are controlled so that the ratio of isocyanate groups to hydroxyl groups used to form the polyurethane is about 1. As discussed above, both Biddle et al. and Wardle teach using an additional hard block polymer.

Menke '661 and Menke '168 teach a binder system for a propellant that can include isocyanate hardening difunctional or trifunctional, hydroxy-substituted glycidylazido polymers. Menke '661 and '168 do not teach that this binder system is a thermoplastic elastomer, that this binder system comprises formed from an aromatic diisocyanate and optionally 2,4-pentanediol, and that the amount of aromatic diisocyanate,

hydroxyl terminated glycidyl azide polymer, and 2,4 pentanediol used to form the polyurethane are controlled so that the ratio of isocyanate groups to hydroxyl groups used to form the polyurethane is about 1.

Thus, Finck et al. in view of Wardle, Biddle et al., Menke '168, and Menke '661 do not disclose or suggest (1) a thermoplastic elastomer that consists essentially of a polyurethane of an aromatic diisocyanate, hydroxyl terminated glycidyl azide polymer, and optionally 2,4-pentanediol and (2) that the amount of aromatic diisocyanate, hydroxyl terminated glycidyl azide polymer, and 2,4 pentanediol used to form the polyurethane are controlled so that the ratio of isocyanate groups to hydroxyl groups used to form the polyurethane is about 1. Therefore, claim 20 is patentable over Finck et al. in view of Wardle, Biddle et al., Menke '168, and Menke '661 and allowance of Claim 20 is respectfully requested.

Claim 22 depends from claim 20 and further recites that the aromatic diisocyanate is 4,4'-methylene bisphenylisocyanate.

As discussed above with respect to claim 20, Finck et al. in view of Wardle, Biddle et al., Menke '168, and Menke '661 do not disclose or suggest (1) a thermoplastic elastomer that consists essentially of a polyurethane of an aromatic diisocyanate, hydroxyl terminated glycidyl azide polymer, and optionally 2,4-pentanediol and (2) that the amount of aromatic diisocyanate, hydroxyl terminated glycidyl azide polymer, and 2,4 pentanediol used to form the polyurethane are controlled so that the ratio of isocyanate groups to hydroxyl groups

used to form the polyurethane is about 1. Therefore, claim 22 is allowable for the same reasons as claim 20 and for the specific limitations recited in claim 22.

Claim 24 depends from claim 20 and further recites that the hydroxyl terminated glycidyl azide polymer has a molecular weight from about 25,000 g/mole to about 35,000 g/mole and a hydroxyl functionality of 2.

As discussed above with respect to claim 20, Finck et al. in view of Wardle, Biddle et al., Menke '168, and Menke '661 do not disclose or suggest (1) a thermoplastic elastomer that consists essentially of a polyurethane of an aromatic diisocyanate, hydroxyl terminated glycidyl azide polymer, and optionally 2,4-pentanediol and (2) that the amount of aromatic diisocyanate, hydroxyl terminated glycidyl azide polymer, and 2,4 pentanediol used to form the polyurethane are controlled so that the ratio of isocyanate groups to hydroxyl groups used to form the polyurethane is about 1. Moreover, Finck et al. in view of Wardle, Biddle et al., Menke '168, and Menke '661 do not teach that the hydroxyl terminated glycidyl azide polymer has a molecular weight from about 25,000 g/mole to about 35,000 g/mole and a hydroxyl functionality of 2. Therefore, claim 24 is allowable for the same reasons as claim 20 and for the specific limitations recited in claim 24.

Claim 25 depends from claim 20 and further recites that the inorganic salt oxidizer is selected from the group consisting of alkali metal nitrates, alkaline earth metal nitrate, alkali metal perchlorates, alkaline earth metal perchlorates, ammonium perchlorate, and ammonium nitrate.



As discussed above with respect to claim 20, Finck et al. in view of Wardle, Biddle et al., Menke '168, and Menke '661 do not disclose or suggest (1) a thermoplastic elastomer that consists essentially of a polyurethane of an aromatic diisocyanate, hydroxyl terminated glycidyl azide polymer, and optionally 2,4-pentanediol and (2) that the amount of aromatic diisocyanate, hydroxyl terminated glycidyl azide polymer, and 2,4 pentanediol used to form the polyurethane are controlled so that the ratio of isocyanate groups to hydroxyl groups used to form the polyurethane is about 1. Therefore, claim 25 is allowable for the same reasons as claim 20 and for the specific limitations recited in claim 25.

Claim 26 depends from claim 20 and further recites that the inorganic salt oxidizer is phase stabilized ammonium nitrate.

As discussed above with respect to claim 20, Finck et al. in view of Wardle, Biddle et al., Menke '168, and Menke '661 do not disclose or suggest (1) a thermoplastic elastomer that consists essentially of a polyurethane of an aromatic diisocyanate, hydroxyl terminated glycidyl azide polymer, and optionally 2,4-pentanediol and (2) that the amount of aromatic diisocyanate, hydroxyl terminated glycidyl azide polymer, and 2,4 pentanediol used to form the polyurethane are controlled so that the ratio of isocyanate groups to hydroxyl groups used to form the polyurethane is about 1. Therefore, claim 26 is allowable for the same reasons as claim 20 and for the specific limitations recited in claim 26.

Claim 27 depends from claim 20 and recites that the gas generating material further comprises a supplemental fuel.

As discussed above with respect to claim 20, Finck et al. in view of Wardle, Biddle et al., Menke '168, and Menke '661 do not disclose or suggest (1) a thermoplastic elastomer that consists essentially of a polyurethane of an aromatic diisocyanate, hydroxyl terminated glycidyl azide polymer, and optionally 2,4-pentanediol and (2) that the amount of aromatic diisocyanate, hydroxyl terminated glycidyl azide polymer, and 2,4 pentanediol used to form the polyurethane are controlled so that the ratio of isocyanate groups to hydroxyl groups used to form the polyurethane is about 1. Therefore, claim 27 is allowable for the same reasons as claim 20 and for the specific limitations recited in claim 27.

Claim 28 depends from claim 27 and further recites that the supplemental fuel is cyclotrimethylenetrinitramine.

As discussed above with respect to claim 20, Finck et al. in view of Wardle, Biddle et al., Menke '168, and Menke '661 do not disclose or suggest (1) a thermoplastic elastomer that consists essentially of a polyurethane of an aromatic diisocyanate, hydroxyl terminated glycidyl azide polymer, and optionally 2,4-pentanediol and (2) that the amount of aromatic diisocyanate, hydroxyl terminated glycidyl azide polymer, and 2,4 pentanediol used to form the polyurethane are controlled so that the ratio of isocyanate groups to hydroxyl groups used to form the polyurethane is about 1. Therefore, claim 28 is allowable for the same reasons as claim 20 and for the specific limitations recited in claim 28.

Claim 29 depends from claim 20 and further recites that the components of the gas generating material are present in a weight ratio adjusted to produce upon combustion a reaction gas product that consists essentially of carbon dioxide, nitrogen, and water.

As discussed above with respect to claim 20, Finck et al. in view of Wardle, Biddle et al., Menke '168, and Menke '661 do not disclose or suggest (1) a thermoplastic elastomer that consists essentially of a polyurethane of an aromatic diisocyanate, hydroxyl terminated glycidyl azide polymer, and optionally 2,4-pentanediol and (2) that the amount of aromatic diisocyanate, hydroxyl terminated glycidyl azide polymer, and 2,4 pentanediol used to form the polyurethane are controlled so that the ratio of isocyanate groups to hydroxyl groups used to form the polyurethane is about 1. Therefore, claim 29 is allowable for the same reasons as claim 20 and for the specific limitations recited in claim 29.

Claim 30 depends from claim 20 and further recites that the polyurethane is formed from an aromatic diisocyanate, hydroxyl terminated glycidyl azide polymer with a hydroxyl functionality of two or less, and 2,4 pentanediol.

As discussed above with respect to claim 20, Finck et al. in view of Wardle, Biddle et al., Menke '168, and Menke '661 do not disclose or suggest (1) a thermoplastic elastomer that consists essentially of a polyurethane of an aromatic diisocyanate, hydroxyl terminated glycidyl azide polymer, and optionally 2,4-pentanediol and (2) that the amount of aromatic diisocyanate, hydroxyl terminated glycidyl azide polymer, and

2,4 pentanediol used to form the polyurethane are controlled so that the ratio of isocyanate groups to hydroxyl groups used to form the polyurethane is about 1. Moreover, Finck et al. in view of Wardle, Biddle et al., Menke '168, and Menke '661 do not disclose or suggest a polyurethane is formed from an aromatic diisocyanate, hydroxyl terminated glycidyl azide polymer with a hydroxyl functionality of two or less, and 2,4 pentanediol. Therefore, claim 30 is allowable for the same reasons as claim 20 and for the specific limitations recited in claim 30.

Claim 35 recites an apparatus comprising an inflatable vehicle occupant protection device and a gas generating material that, when ignited produces gas to inflate the inflatable vehicle occupant protection device. The gas generating material comprises about 65% to about 90%, by weight of the gas generating material, an inorganic oxidizer salt and about 5% to about 35%, by weight of the gas generating material a thermoplastic elastomer. The thermoplastic elastomer comprises a polyurethane formed from 4,4'-methylene bis-phenylisocyanate, a hydroxyl terminated glycidyl azide polymer with a hydroxyl functionality of two or less, and optionally 2,4 pentanediol. The amount 4,4'-methylene bis-phenylisocyanate, hydroxyl terminated glycidyl azide polymer, and 2,4 pentanediol used to form the polyurethane are controlled so that the ratio of isocyanate groups to the hydroxyl groups used to form the polyurethane thermoplastic elastomer is about 1.

As discussed above with respect to claim 20, Finck et al. in view of Wardle, Biddle et al., Menke '168, and Menke '661 do not disclose or suggest (1) a thermoplastic elastomer that consists essentially of a polyurethane of an aromatic diisocyanate, hydroxyl terminated glycidyl azide polymer, and optionally 2,4-pentanediol and (2) that the amount of aromatic diisocyanate, hydroxyl terminated glycidyl azide polymer, and 2,4 pentanediol used to form the polyurethane are controlled so that the ratio of isocyanate groups to hydroxyl groups used to form the polyurethane is about 1. Therefore, claim 35 is allowable for the same reasons as claim 20 and for the specific limitations recited in claim 35.

Claim 36 depends from claim 35 and further recites that the polyurethane is formed from 4,4'-methylene bis-phenylisocyanate, a hydroxyl terminated glycidyl azide polymer with a hydroxyl functionality of two or less, and 2,4 pentanediol.

As discussed above with respect to claim 20, Finck et al. in view of Wardle, Biddle et al., Menke '168, and Menke '661 do not disclose or suggest (1) a thermoplastic elastomer that consists essentially of a polyurethane of an aromatic diisocyanate, hydroxyl terminated glycidyl azide polymer, and optionally 2,4-pentanediol and (2) that the amount of aromatic diisocyanate, hydroxyl terminated glycidyl azide polymer, and 2,4 pentanediol used to form the polyurethane are controlled so that the ratio of isocyanate groups to hydroxyl groups used to form the polyurethane is about 1. Therefore, claim 36

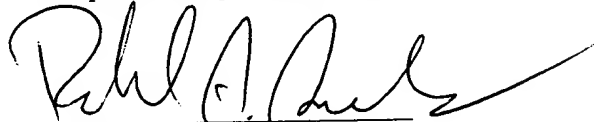
is allowable for the same reasons as claim 20 and for the specific limitations recited in claim 36.

In view of the foregoing, it is respectfully submitted that the above-identified application is in condition of allowance, allowance of the above-identified application is respectfully requested.

Attached hereto is a marked-up version of the changes made to the specification by the current amendment. The attached page is captioned "Version with markings to show changes made."

Please charge any deficiency or credit any overpayment in the fees for this amendment to our Deposit Account No. 20-0090.

Respectfully submitted,



Richard A. Sutkus  
Reg. No. 43,941

TAROLLI, SUNDHEIM, COVELL  
& TUMMINO L.L.P.  
526 Superior Avenue - Suite 1111  
Cleveland, Ohio 44114-1400  
Phone: (216) 621-2234  
Fax: (216) 621-4072  
CUSTOMER NO.: 26294

VERSION WITH MARKINGS TO SHOW CHANGES MADE

IN THE SPECIFICATION:

The paragraph beginning at line 12, of page 10 has been amended as follows:

--In a preferred embodiment, 4,4'-methylene bis-phenylisocyanate is reacted with GAP 1000 to form linear block copolymers (i.e. GAP-M). The reaction scheme of this process is illustrated as follows:--

IN THE CLAIMS:

Claim 30 has been amended as follows:

30. (Amended) The apparatus of claim 20 wherein said polyurethane is formed ~~from~~ from an aromatic diisocyanate, hydroxyl terminated glycidyl azide polymer with a hydroxyl functionality of two or less, and ~~a secondary diol~~ 2,4-pentanediol.

Claim 35 has been amended as follows:

35. (Thrice amended) An apparatus comprising an inflatable vehicle occupant protection device and a gas generating material that, when ignited produces gas to inflate the inflatable vehicle occupant protection device, the gas generating material comprising:

about 65% to about 90%, by weight of the gas generating material, an inorganic oxidizer salt; and'

about 5% to about 35%, by weight of the gas generating material a thermoplastic elastomer, said thermoplastic elastomer being a polyurethane formed from 4,4'-

methylene bis-phenylisocyanate, a hydroxyl terminated glycidyl azide polymer with a hydroxyl functionality of two or less, and optionally a ~~secondary diol~~ 2,4-pentanediol, wherein the amount of 4,4'-methylene bis-phenylisocyanate, hydroxyl terminated glycidyl azide polymer, and ~~secondary diol~~ 2,4-pentanediol used to form the polyurethane are controlled so that the ratio of isocyanate groups to hydroxyl groups used to form the polyurethane is about 1.